

Geographic variation in *Sphaerodactylus notatus* Baird

by

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(Received for publication November 14, 1964)

Seven nominal species of geckos of the genus *Sphaerodactylus* are known from the Bahama Islands. Of these, two (*decoratus* Garman and *anthracinus* Cope) differ from the remaining five in having combinations of characters which differentiate them from the balance of the species, all of which have a certain community of characters. The affinities of *anthracinus* are with Hispaniolan and Cuban members of the genus (SCHWARTZ, 9), whereas *decoratus* has two Cuban subspecies (SCHWARTZ, 8). The remaining five forms (*notatus* Baird, *corticolus* Garman, *mariguanae* Cochran, *inaguae* Noble and Klingel, *caicosensis* Cochran) are alike in that they all possess large, keeled, imbricating dorsals and smooth ventrals; *corticolus*, *mariguanae*, and *caicosensis* have keeled gular scales while *notatus* and *inaguae* have these scales smooth. At least *mariguanae* and *corticolus* are large forms (snout-vent lengths up to 40 mm); *caicosensis* is somewhat smaller (snout-vent length 31 mm). Of the seven Bahaman species, I have collected all but *corticolus*, and through the efforts of Dennis R. Paulson, I have seen specimens of this species very freshly preserved. The present paper will deal exclusively with the two species *notatus* and *inaguae*, which have keeled and imbricating dorsals, smooth gulars, and smooth ventrals.

Aside from specimens collected by myself and parties (designated Albert Schwartz Field Series (ASFS)), I have borrowed material from the American Museum of Natural History (AMNH), Carnegie Museum (CM), Museum of Comparative Zoology (MCZ), Museum of Natural History, University of Kansas (KU), United States National Museum (USNM), Museum of Zoology, University of Michigan (UMMZ), Museum of Natural History, Brigham Young University (BYU), and from the personal collections of Dennis R. Paulson (DRP). To the curators of the above collections - Charles M. Bogert, Neil D. Richmand, Ernest E. Williams, William E. Duellman, Doris M. Cochran, Charles F. Walker, George R. Zug, and Wilmer W. Tanner - I express my thanks in being allowed to

examine specimens under their care. The figures are the work of Ronald F. Klinikowski; in the Bahamas I have had the assistance of Patricia A. Heinlein, Ronald F. Klinikowski, David C. Leber, Dennis R. and Mary Lynn Paulson, and Richard Thomas, and additionally in Cuba, the help of Barton L. Smith, James D. Smallwood and George R. Zug. Mr. Paulson made a special effort to secure specimens of *S. corticolus* for me on San Salvador. To all the above I wish to extend my gratitude for their help in many ways. My Cuban collecting was under the sponsorship of two National Science Foundation grants (G-3865 and G-6252).

Sphaerodactylus notatus Baird was described in 1858 from material from Key West, Monroe County, Florida. Since that time, the species has been reported from Cuba, the Isla de Pinos, and various Bahama islands. As a matter of fact, the species occurs on all the major islands in the Grand Bahama Bank with the exception of Andros, and on the Little Bahama Bank as well. COCHRAN (3) reported specimens from the Archipiélago de los Canarreos to the east of the Isla de Pinos, listing specimens from Cayo Avillon (= Cayo Avalos) and Cayo Contelos (= Cayo Cantiles). BARBOUR (1) described *S. exsul* from Little Swan Island off the coast of Honduras; *exsul* is obviously a close relative of *S. notatus* and will be discussed herein. Finally, during the course of the present study, I have examined two specimens from the Morant Cays which likewise are referable to *S. notatus*. There is a single anomalous specimen, reported by COCHRAN (*loc. cit.*) from Great Inagua; this specimen is the only evidence that both *notatus* and *inaguae* occur together on this island. However, as Cochran has pointed out, "Matthewtown... is a port for West Indian shipping... and hence the occurrence of a form like *notatus*, known to be an inveterate traveler, is to be expected occasionally"; I do not attach any significance to this chance occurrence of *notatus* on Great Inagua, and regard the specimen as a waif from elsewhere.

Throughout its range, *S. notatus* varies in several characters, *viz.*, adult size (from 24 mm to 34 mm), number of dorsals in axilla to groin distance (from 18 to 36), number of midbody scales (from 35 to 55). All counts have been taken in the manner proposed and outlined by KING (6). Additionally, various populations vary chromatically insofar as the presence or absence of a scapular blotch with two pale ocelli; in some populations, both sexes show the feature equally well, in others neither sex shows it, and in still another it appears to be present in females and absent in males. There are also average differences in length and breadth of the escutcheon in males, number of lamellae under the fourth toe (although the modal number for all populations except one is the same), and ventral scales in the axilla to groin distance. The latter count is less significant in general than are those previously noted.

I suspect that there are color differences in the various populations. I have collected or examined live *notatus* from Florida, Cuba, Isla de Pinos, South Bimini and Eleuthera, and seen freshly preserved specimens from Cat Island and Grand Bahama. Isla de Pinos specimens were strikingly yellow-headed and yellow-tailed in life, and were thus color-wise distinctly different from Cuban specimens. Eleuthera, South Bimini, and Cat Island specimens were much alike

in the drab tones, and Cuban specimens likewise are not colorful. The color descriptions by NOBLE and KLINGEL (7) of *S. inaguae* are borne out by my own observations on a very few specimens of that species in life.

SEXUAL DICHROMATISM

As has been pointed out (DUELLMAN and SCHWARTZ, 4), *S. notatus* in Florida is distinctly dichromatic: "In males the entire dorsal surface of the body is spotted with dark punctations, each of which consists of a single darkened scale. There is no tendency for the head spots to be arranged in either transverse or longitudinal rows or to form stripes. The gular region is strongly pigmented with dark spots... Females have three longitudinal dark stripes on the head, one median and two postocular. The centers of these stripes are lighter than borders; this is especially true of the median stripe. Posterior to the scapular region the dorsum has the same dark punctations as the males". SMITH (10) mentioned specimens that were intermediate between these patterns as well as unicolor individuals. The latter are old males in which all traces of the spots have been lost... Males always have spotted heads; in females, the dark lines of rows of spots or dashes, perhaps ill-defined, are always present".

Thus, males, once they have lost their juvenile female head pattern, assume a head pattern of discrete dots which apparently later disappear, rendering the head unicolor. The body is spotted with dark punctations in adult males as well as females. The head pattern of females consists of three longitudinal lines, which in turn in old females may become very obscured by deposition of dark pigment, so that in an extreme case the entire dorsal surface of the lizard is quite dark with little discernible pattern. The juvenile pattern in both sexes is that of adult females, although in young specimens the pattern is usually brighter and more clear-cut than in adult females.

The degree of throat pigmentation is correlated with the degree of head spotting in males. Those males with large and distinct head spots have throats which are heavily pigmented. In some populations, however, the throats of males are never heavily pigmented, despite the maturity of the gecko; at best in these populations the throat of mature males has a few very pale scattered grayish to brown dots, never the bold and complex pattern of adults from other areas.

Some populations have a dark scapular spot including two pale ocelli. In Florida, this condition is known to occur only in females, where the spot may be extremely faded and obscure, and may be reduced as well to only the barest vestiges of the ocelli. In Cuba, the scapular spot and ocelli occur in both sexes, but rarely and without geographic or age correlation. In specimens from the Isla de Pinos, the spot is absent entirely. On the Grand Bahama Bank the spot is absent in both sexes, but on Little Bahama Bank specimens it is present (or at least indicated) in some individuals of both sexes. Finally, on Little Swan Island, both sexes have the spot present or at least indicated.

Juvenile *notatus*, as mentioned above, have an intensified female pattern. Thus, one would expect that, if a scapular spot and ocelli are present in adults

of either sex, these elements would likewise be present in juveniles. Just as in the adults noted above, juveniles show the same variation. In juveniles from Florida, the scapular spot is present, in Cuba the spots occur randomly in juveniles, and on the Isla de Pinos, scapular spots and ocelli are lacking in juveniles. Juveniles from the Bahamas follow the respective conditions of the adults, whether from the Great or Little Bahama banks. Little Swan juveniles have scapular spots.

Sphaerodactylus notatus Baird

Sphaerodactylus notatus Baird, 1858, Proc. Acad. Nat. Sci. Philadelphia, 10: 254.

DIAGNOSIS. A sphaerodactyl with large, acute, strongly keeled, imbricating dorsal scales, and without a middorsal zone of granules. Ventrals smooth; gular and chest scales smooth. Internasals 0 to 2, upper labials to center of eye usually three. Ground color brown with a sexually dichromatic pattern of spotted head and back in males, longitudinally lined head in females; a dark scapular spot and ocelli present in both sexes to absent in both sexes. Adult size from 24 mm to 34 mm; dorsal scales between axilla and groin from 23 to 38; midbody scales from 35 to 55; fourth toe lamellae from 5 to 13; escutcheon in males a rather large median patch with branches extending almost to the knee along the underside of the thighs, 2 to 7 scales in length, 7 to 29 scales in breadth.

Sphaerodactylus notatus notatus Baird

TYPE LOCALITY: Key West, Monroe County, Florida.

DISTRIBUTION: Known only from the Florida Keys and the southern Florida mainland in Dade, Broward, and Monroe counties.

DEFINITION: A subspecies of *Sphaerodactylus notatus* characterized by moderate size (adult males to 29 mm snout-vent length, adult females to 30 mm snout-vent length), moderate number of dorsal scales between axilla and groin (22 to 29, mean 23.8 ± 0.40), moderate number of scales around body at midbody (41 to 48, mean 44.3 ± 0.36), throats of adult males heavily spotted with dark brown, and presence of a dark scapular patch and two pale ocelli in juveniles and adult females, but absent in fully adult males.

DISCUSSION: The pattern description quoted above discusses at some length the sexual dichromatism in *S. n. notatus*. No mention was made of the scapular spot or ocelli, however. SMITH (10) illustrated both sexes from the Florida Keys, and his photographs clearly show the adult male without a scapular spot and a female with one clearly defined. All females, however, do not show the scapular spot so prominently as in this illustrated individual. Of seventy-one adult females at hand from both the Keys and the mainland, all but three (two from Little Torch Key, one from Elliott's Key) show some indication of the scapular spot, either with it well developed and including two white ocelli, or represented by a slightly darkened area, or by two pale ocelli surrounded by only a very small dusky area. The three females which apparently lack this feature

may merely have it very obscured and faint. All juveniles examined have the spot and ocelli much more prominent and thus these specimens agree much better with Smith's photograph. Males, once they have acquired the adult spotted pattern and have lost the juvenile (i.e., = adult female) head striping, show no indication whatsoever of a scapular spot and ocelli, and the pattern is completely of dark spots on the head and body. Subadult males (or fully sized males which as yet not acquired the heavily spotted head and throat) may show faint indications of the ocelli, but those individuals which do demonstrate this feature invariably have remnants of the female head striping still present. I regard the occurrence of the scapular spot and ocelli in fully grown males as a retention of part of the juvenile-female pattern.

Males have the throat spotted with dark brown; the degree of throat spotting is correlated with the degree of assumption of dorsal adult spotting, but in all adult males there is some distinct throat spotting present. Females on the other hand have the throat virtually immaculate except for a few faint brownish dots or streaks which are very inconspicuous. In preserved specimens the venter is cream colored with usually some dark pigment deposited on the more posterior scales; in males the venter seems to be somewhat more heavily pigmented than in females. No females show any obliteration of the prominent head stripes with increasing size. The iris is brown, flecked with gold, and with a golden pupillary ring.

In addition to the scale counts given in the definition, the ventral scales between axilla and groin vary between 25 and 33 (mean, 28.6), and the escutcheon measures $2 - 5 \times 15 - 26$. There seems to be a very slight sexual dimorphism in size, with females slightly larger than males. The fourth toe lamellae vary from 8 to 12 (mode, 10; mean 9.6). The internasals vary between 0 and 2, with only three geckos of twenty-four having counts of 2 and two specimens having counts of 0. All but three individuals, which have two upper labials, have the three upper labials to the center of the eye. I can detect no differences in counts or pigmentation and pattern between specimens from the Keys and the specimens from the mainland.

SPECIMENS EXAMINED: *Florida, Monroe County*, Dry Tortugas, 1 (UMMZ 71002); Key West, 73 (DRP 1970, 3045-47; MCZ 4317, 4386 (3 specimens), 29218, 31497-98, 31636-42; UMMZ 79190 (16 specimens), 95583 (34 specimens), 115995 (2 specimens), 106030, 106032, 108181; Stock Island, 10 (DRP 520, 1275; UMMZ 108352, 112396 (6 specimens)); Cudjoe Key, 1 (UMMZ 108351); Little Torch Key, 2 (UMMZ 108183); Big Pine Key, 2 (UMMZ 103735, 107190); Islamorada, Upper Matecumbe Key, 5 (MCZ 13470-74); Plantation Key, 1 (UMMZ 108179); Key Largo, 14 (UMMZ 102541 (6 specimens), 103742, 108178, 108182, 108180 (5 specimens)); 6 mi. N Flamingo, 1 (UMMZ 118515); *Dade County*, Miami, 1 (DRP 12); Miami, Fairchild Gardens, 27 (UMMZ 1185117); Miami Beach, Fisher's Island, 1 (UMMZ 95055); Coconut Grove, 1 (UMMZ 121411); Matheson Hammock, 8 (UMMZ 108349, 109390 (4 specimens), 109393 (3 specimens)); 4.1 mi. SW Paradise Key, 1 (UMMZ 109391); Elliott Key, 7 (UMMZ 106039 (6 specimens), 106040); *Broward County*, H. T. Birch State Park, 3 (UMMZ 108350 (2 specimens), 109392).

Sphaerodactylus notatus atactus, new subspecies

TYPE: AMNH 92820, and adult female, 7 miles west of Aserradero, Oriente Province, Cuba, taken 12 August 1960, one of a series collected by Ronald F. Klinikowski, David C. Leber, A. Schwartz, and James D. Smallwood. Original number 9836.

PARATYPES (all from Oriente Province, Cuba), as follows: AMNH 92812-19, same data as type; AMNH 83601-02, 9 km W, 3 km S Baracoa, 10 August 1959, A. Schwartz; AMNH 83746, Taco Bay, 21 December 1959, A. Schwartz; AMNH 17718, Patana, costa sur, Baracoa, V. Rodríguez; USNM 42898, Baracoa, January-February 1908, J. R. Johnston; USNM 69337, Baracoa, 29 June 1925, C. E. Price; KU 55166, Baracoa, 29 May 1953, T. H. Eaton; MCZ 11215, Cueva de la Majana, Baracoa, V. J. Rodríguez; MCZ 13595-96, Jaucó, seacoast, Cabo Maisí, V. J. Rodríguez, 1819; MCZ 8513, Mt. Líbano, Guantánamo, 1913, T. Barbour; MEZ 11060, UMMZ 90928, San Carlos, Guantánamo, 1915, C. Ramsden; MCZ 13449-51, Siboney, 1913, V. J. Rodríguez; UMMZ 90627 (2 specimens), Siboney, V. J. Rodríguez; MCZ 8542, Los Negros, Jiguaní, 1913, T. Barbour; UMMZ 90629, Los Negros, Jiguaní, T. Barbour; MCZ 42485-86, coast south of Pico Turquino, June 1936, P. J. Darlington; MCZ 45701, Cayo del Rey, April 1940, T. P. Carabia; MCZ 59317, nr. San Ramón, west of Campechuela, 18 July 1958, R. Molina and R. Ruibal; MCZ 13460-62, Cananova, V. J. Rodríguez; BYU 17167-82, Banos, April 1956, A. Spielman.

ASSOCIATED SPECIMENS: Cuba, Pinar del Río Province, 7.6 mi. E Isabel Rubio (AMNH 78343); Guane (MCZ 10914); San Diego de los Baños (MCZ 7919); Habana Province, cay west of channel (USNM 81764-65); Marianao, La Habana (UMMZ 78488); Las Villas Province, Soledad (MCZ 7920); Camagüey Province, Loma de Cunagua, 12 mi. E Morón (AMNH 78344-45); Finca El Porvenir, Loma de la Yagua, 24 km SW Camagüey (AMNH 78345); Finca Sta. Teresa, 9 km W Camagüey (MCZ 57346-52).

DISTRIBUTION: Cuba, Isla de Pinos and associated islets; see also discussion of specimens from Great Inagua and Morant Cays.

DIAGNOSIS: A subspecies of *Sphaerodactylus notatus* characterized by a combination of moderate size (adult males to 29 mm snout-vent length, adult females to 30 mm snout-vent length), small number of dorsal scales between axilla and groin (18 to 28, mean 22.1 ± 0.30), small number of scales around body at midbody (36 to 49, mean 41.9 ± 0.40), adult male dorsal pattern usually not heavily spotted, throat spotting present or absent in adult males, and adults of both sexes with or without scapular spot and ocelli.

DESCRIPTION OF TYPE: An adult female with the following measurements and counts: snout-vent length, 27 mm; tail, 21 mm, regenerated; dorsal scales between axilla and groin, 21; ventral scales between axilla and groin, 26; scales

around body at midbody, 40; internasals, 2; upper labials to center of eye, 3; fourth toe lamellae, 7.

Dorsum tannish-brown, very faintly marked with tiny darker brown flecks (which are actually the outer halves of the dorsal scales which are more darkly pigmented) more or less aligned into longitudinal lines; head tan with three dark brown longitudinal lines, the central one beginning about four scales posterior to the rostral and extending onto the occiput where it is expanded, and thence dividing on the neck, the double stripe continuing posteriorly over about one half the trunk and gradually fading into ground color; the two lateral head stripes beginning at the nares, crossing the eye, continuing across the temporal region, expanding slightly on the neck and shoulders, and becoming fainter on the anterior quarter of the trunk; a short postocular longitudinal dash between the median and lateral head stripe on each side; upper surface of limbs and unregenerated tail tan with free edges of scales black; all ventral surfaces cream with some scales having their free edges stippled heavily with brown, the most heavily pigmented scales those of the posterior abdomen, and undersides of tail and limbs; chin and throat finely and irregularly stippled with dark brown, the stippling not forming any pattern.

VARIATION: The type, paratypes, and associated specimens (fifty-one lizards in all) show the following data: males and females are grouped together since there is no sexual dimorphism in numbers of scales, lamellae, etc. Dorsals between axilla and groin, 18 to 28 (mean, 22.1); ventrals between axilla and groin, 24 to 33 (mean, 26.6); midbody scales, 36 to 49 (mean, 41.8); internasals, 0 to 2 (mode, 1); upper labials to center of eye, 2 to 4 (mode, 3); fourth toe lamellae, 7 to 12 (mean, 9.8; mode, 9 or 10); escutcheon, 4 to 7 \times 18 to 26. Largest male, 29 mm snout-vent, largest female, 30 mm snout-vent.

Of the series of *S. n. atactus*, many are old specimens and thus cannot be used for pattern data. In general the dorsal coloration is tan to brown; only the largest males have a tendency to acquire the heavily spotted adult male pattern of *n. notatus*, and even these individuals do not have the contrastingly spotted pattern of the nominate subspecies. In most males, there is still a faint remnant of the three female head lines, and two individuals (MCZ 57364-47) show this pattern in the process of breaking up — the intensification of the dark margins of the lines, these margins then becoming fragmented and disjointed. Five males (all from various Oriente localities) have some indication of the scapular spot and ocelli; in two of these the ocelli are present, and surrounded by a dark ring. In two, there is a dark blush and two ocelli, whereas the last has only a single ocellus. These five specimens vary in snout-vent length between 24 and 29 mm, and thus include the largest male. A male paratopotype, however, with a snout-vent length of 27, as well as other specimens intermediate in size between the ocellate specimens listed above, lacks the ocelli.

In females, the same situation exists. Nine females have scapular markings; five have the two ocelli in a diffuse dark area, two have darkly-ringed separate ocelli, and two have two black dots on the shoulders. These are all

intermediately sized specimens (snout-vent lengths between 21 and 27 mm) and all are from various Oriente localities. In both sexes the longitudinal head lines may continue, when present, far posteriorly onto the trunk, occasionally being discernible almost as far as the groin. Some females, like the type, are dotted with dark brown as is the type, and others are virtually patternless on the body.

The few juveniles available show the same strange variation in occurrence of the scapular spot and ocelli. It is reasonable that the presence or absence of the spot is not due to ontogenetic change (a well-known vagary of *Sphaerodactylus* patterns), but is rather genetically determined. Apparently some individuals have spots from hatching until adulthood and others simply never have them.

The throat pattern of males is likewise variable, although this seems to be correlated with degree of head spotting; those lizards with spotted heads have moderately prominent throat spotting, whereas other apparently fully adult males lack both head and throat spotting.

One female requires special comment. This is a lizard from Finca El Porvenir, Camagüey Province; it is the largest female *atactus* available with a snout-vent length of 30 mm. The entire head pattern is obliterated by dark brown vermiculations so that the head lines are only discernible in the vaguest fashion. The body is dark brown with darker brown spots, one scale in size, and the belly is darkly pigmented as well. No other specimen of the species equals this female in obliteration of pattern and depth of pigmentation.

COMPARISONS: *S. n. atactus* differs from *S. n. notatus* in having less dorsal and midbody scales; although the ranges of these counts overlap in these two forms, the differences are statistically significant. Both races are equal in adult size; all female *n. notatus* have the scapular spot and ocelli at least indicated, whereas most *n. atactus* females lack the spot and ocelli (although it does occur in a few adults). Males of the two forms may be distinguished by the much heavier throat, head, and body spotting in *notatus*, and the absence of the scapular spot and ocelli in *notatus* (although many *atactus* males lack it also).

REMARKS: Perhaps one of the strangest by-products of the present study is the apparent relative abundance of *S. n. atactus* in Cuba. I had considered that there might be a good possibility that there might be geographic variation in *S. notatus* in Cuba; several other island-wide lizards are distinctly variable in many characteristics and there was a possibility that this gecko might be equally so. After having assembled the material for the present study, I was astonished to discover that there were virtually no specimens from the western two thirds of Cuba. Of the sixty-eight lizards examined, all but seven are from the eastern provinces of Camagüey and Oriente, and of these seven, two are from an off-shore islet in Habana Province. Certainly my own experience in Cuba shows that *S. notatus* is commoner in Oriente than elsewhere. At the type locality of *atactus*, these small lizards farly swarmed in fallen *Coccoloba* leaves along the coast. In Pinar del Río on the other hand, despite much intensive collecting over several years' time, only one individual was encountered. The lack of series of

specimens from such favorite collecting sites as Soledad in Las Villas Province and La Habana is suggestive that the species is not common in the western two thirds of Cuba.

There are available twenty-two specimens from the Isla de Pinos and the Archipiélago de los Canarreos, as follows: *Isla de Pinos*, no further locality (CM 993); Punto del Este, 2 (AMNH 81373-74); Sierra de las Casas, just W Nueva Gerona, 4 (AMNH 78347-49, 81377); east base, Sierra de las Casas, just W Nueva Gerona, 2 (AMNH 81375-76); 1 mi. SSW Nueva Gerona, east base, Sierra de las Casas (AMNH 81372); Nueva Gerona (KU 55140); Paso de Piedras, *ca.* 20 km SSW Santa Fé (AMNH 78346); *Archipiélago de los Canarreos*, Cayo Avalos, 8 (USNM 81767-74); Cayo Cantiles (USNM 81775). These specimens deserve special comment.

In size, the Isla de Pinos specimens equal Cuban specimens, the largest male having a snout-vent length of 30 mm, the largest female 29 mm. In scalation, the Isla de Pinos and Archipiélago specimens together are comparable to Cuban specimens; for example, dorsals between axilla and groin number from 20 to 26 (mean, 22.9), midbody scales lie between 35 and 47 (mean, 41.5), fourth toe lamellae range from 7 to 11 (mean, 9.5; mode, 10). There are thus no scale differences between the Cuban and Isla de Pinos specimens. In pattern, no specimens from the Isla nor the Archipiélago has a scapular spot or ocelli; this includes three juveniles. There seem to be no pattern differences except that four adult males from the Isla itself lack any sort of "adult" *notatus* spotting, either on the head, body, or throat. Females are somewhat more boldly marked on the head than are Cuban females. The escutcheon in four Isla de Pinos males has the same length (4 to 7 scales) as do those of Cuban males, but the breadth of the escutcheon on the Isla de Pinos ranges from 7 to 19 scales, in contrast to 18 to 26 on Cuba.

The small series from Cayo Avalos (all females) and the single male from Cayo Cantiles also present some differences when compared with Isla de Pinos specimens themselves. The largest Archipiélago specimens measure only 24 mm snout-vent, and have distinctly less scales in axilla to groin and midbody counts than Isla specimens. The escutcheon of the single male is 5×17 scales, thus like the Isla males. The entire series from Cayo Avalos is very disiccated, and little can be determined patternwise upon it; however, none of these females has a scapular spot or ocelli and the same is true of the Cantiles male, which is also not spotted on the head, throat, or body. All but three of the Archipiélago specimens have two internasals (63%); on the Isla de Pinos, 58% of the specimens have two internasals, and on Cuba only 14%. There is a strong tendency for Isla and Archipiélago specimens to have two internasals in contrast to Cuban *S. notatus*.

The assignment of these specimens is dubious. I feel that they may well merit description as a new subspecies, differing from *S. n. atactus* only in complete absence of a scapular spot and ocelli, possibly in complete reduction of head, throat and body spotting in adult males, smaller escutcheon, and higher incidence of two internasals. However, due to the small series involved, and especially to

the poor condition of the Archipiélago material, it seems preferable to await the possibility of securing at some future date more adequate material from the Isla de Pinos and its associated keys, and for the moment regard these specimens as *S. n. atactus*.

Sphaerodactylus notatus exsul Barbour

Sphaerodactylus exsul Barbour, 1914, Mem. Mus. Comp. Zool., 44(2):264.

TYPE LOCALITY: Little Swan Island, Caribbean Sea.

DISTRIBUTION: Known only from Little Swan Island.

DEFINITION: A subspecies of *Sphaerodactylus notatus* characterized by small size (adult males to 24 mm snout-vent length, adult females to 23 mm snout-vent length), moderate number of dorsal scales between axilla and groin (23 to 29, mean 25.8 ± 0.45), small number of scales around body at midbody (37 to 44, mean 41.5 ± 0.55), throats of males usually with some dark pattern of dots or lines, presence of a scapular patch and ocelli in both sexes, and small escutcheon in males.

DISCUSSION: BARBOUR (1) defined *S. exsul* as being closely related to *S. notatus* but differing from that species in "having slightly smaller and very much more weakly keeled dorsal scales. Its coloration is similar in type but much brighter and more varied. A conspicuous spectacle-like marking with two white spots is often seen on the posterior neck region. I have not observed this in *S. notatus*".

This diagnosis is essentially correct. I have examined the type and fourteen paratypes (MCZ 7894, MCZ 9959-62, 9965-68, 9970-75), and agree that the scapular spot and ocelli are present or at least indicated in all specimens, regardless of sex or maturity; this in itself distinguishes the Little Swan Island form from both *S. n. notatus* and *S. n. atactus*. The dorsal scales in *exsul* are quite comparable in structure to those of *S. notatus*; the head pattern in the females is likewise generally the same, and not especially brighter as Barbour thought. In males only the heads may be spotted, and no specimen shows the large body dots of male *notatus* from Florida. The male throat pattern (when present) consists of either many fine pale brown dots or a series of dark brown dots medially with two more or less complete dark brown longitudinal lines on each side of the throat. The relationships of *S. exsul* are so obviously with *S. notatus* that the former should be regarded as a subspecies of the latter.

Scalewise, *exsul* may be distinguished from *notatus* by its greater number of dorsals between axilla and groin, and lesser number of scales around midbody. Compared with *atactus*, *exsul* has a greater number of dorsals and an equal number of midbody scales and ventrals. The escutcheon is smaller in *exsul*, reaching a maximum breadth of 23 scales, whereas in *notatus* and *atactus* the escutcheon reaches a breadth of 26 scales. The length of all escutcheons of *exsul* (six specimens) is five scales, whereas this length varies in *notatus* between 2 and 5

and in *atactus* between 4 and 7. Finally, the fourth toe lamellae average 9.1 in *exsul*, 9.8 in Cuban *atactus*, and 9.6 in *notatus*. Both the Floridian and Cuban races reach a larger adult size (30 mm) than does *exsul* (24 mm). All but one specimen of *exsul* have one internasal; the exception lacks this scale.

Sphaerodactylus notatus amaurus, new subspecies

TYPE: MCZ 77162, an adult female, Alicetown, Eleuthera, Bahama Islands, taken 3 November 1961, one of a series collected by natives. Original number 17513.

PARATYPES (all from Eleuthera, Bahama Islands): ASFS 17503, same locality and collectors as type, 1 November 1961; ASFS 17514-16, same data as type; ASFS 17528-36, same locality and collectors as type, 4 November 1961; UIMNH (University of Illinois, Museum of Natural History) 55621-25, same locality and collectors as type, 6 November 1961; AMNH 69247-49, Hatchet Bay, 5 April 1948, G. Campbell; AMNH 69250, AMNH 69257, Hatchet Bay, 14 July 1948, G. Campbell; MCZ 37962, Bannermantown, February 1934, T. Barbour; UMMZ 112247, Governor's Harbour, 31 March 1953, G. B. Rabb.

ASSOCIATED SPECIMENS: *Bahama Islands, Long Island, Clarendtown*, AMNH 74772-74, UMMZ 112246 (3 specimens), MCZ 4436 (2 specimens); Mortimer's South Point, MCZ 39759-61; *Cat Island, McQueen*, AMNH 74770-71; Orange Creek, 1.5 mi. NW Arthur's Town, MCZ 39563-69; Blue Hole Hill, 3 mi. N Arthur's Town, MCZ 39570; Arthur's Town, MCZ 39571-79 (79 specimens), UMMZ 79446 (25 specimens); The Bight, ASFS V2128-30, ASFS V2142, ASFS V2233; *Exuma Cays, Leaf Cay of Allen's Cays*, AMNH 74764-65; Little Norman's Cay, MCZ 13475-77; Warderick Wells Cay, UMMZ 112243, UMMZ 112244 (2 specimens); Bell Island, AMNH 74766; Bitter Guana Cay, UMMZ 112245; Darby Island, AMNH 74767-69; Great Exuma Island, cay opposite Roseville, MCZ 13443-46; *Ragged Cays, South Channel Cays*, USNM 81471; *New Providence*, MCZ 8213, UMMZ 53021; Nassau, USNM 26079, USNM 38174-76, UMMZ 112248, AMNH 74762-63; *South Bimini*, AMNH 68797-99, AMNH 68800 (4 specimens), AMNH 68801 (3 specimens), AMNH 68802, AMNH 68803 (8 specimens), AMNH 68804; east end, AMNH 68805; west end, AMNH 68918, ASFS X4628-32, ASFS X4761-62, ASFS X4782; western side, ASFS X4670-82; "Bimini", AMNH 73492.

DISTRIBUTION: Great Bahama Bank except Andros¹; Cat Island; South

1. Since the present paper was submitted for publication, *S. notatus* has been collected on Andros (ASFS V6964-65, vicinity of Nicholl's Town; ASFS V6976, west side, Morgan's Bluff), Great Exuma (ASFS V6986, 5.6 mi. SE Rolleville; ASFS V7010, 0.8 mi. NW Gregory Town; ASFS V7015, 3.2 mi. NW George Town; ASFS V7096, George Town), and Little Exuma (ASFS V7051, 5.7 mi. SE The Ferry). These specimens represent the first records of *S. notatus* from these islands, and all agree with the diagnosis of *S. n. amaurus*. The above specimens were collected by Richard Thomas. Wayne King advises me that *S. notatus* is moderately abundant on the west coast of Andros, whence he collected series now in the collection of the University of Florida.

Bimini.

DIAGNOSIS: A subspecies of *Sphaerodactylus notatus* characterized by a combination of small size (adults of both sexes to 26 mm snout-vent length), large number of dorsal scales between axilla and groin (23 to 33, mean 27.3 ± 0.24), large number of scales around body at midbody (41 to 54, mean 46.7 ± 0.32), adult male pattern usually not heavily spotted, throat weakly spotted to immaculate in males, and scapular spot absent in both sexes, although occasionally barely indicated in females.

DESCRIPTION OF TYPE: An adult female with the following measurements and counts: snout-vent length, 25 mm; tail, 24, complete; dorsal scales between axilla and groin, 28; ventral scales between axilla and groin, 33; scales around body at midbody, 43; internasals, 1; upper labials to center of eye, 3; fourth toe lamellae, 10.

Dorsum tannish-brown, marked with darker brown flecks, one scale in size, which are arranged over the entire dorsum from the shoulders to the sacrum in vaguely linear series, although no lines as such are apparent; head tan with three longitudinal lines as typical of the species, the lateral lines beginning at the nares, proceeding posteriorly across the eye, over the temporal region onto the shoulders; median head stripe beginning just anterior to eyes and extending onto the neck, its widest portion in the occipital area; a small postocular dot in the tan area on each side between the head stripes; upper sides of limbs and tail tan with free edges of scales black; all ventral surfaces cream with some scales having their free edges stippled with dark brown, especially those of the posterior belly, limbs and throat; chin faintly stippled with dark brown, and patternless. No scapular spot nor ocelli.

VARIATION: Seventy-nine specimens of *S. n. amaurus*, including type, adult paratypes, and associated specimens from throughout the range of the subspecies show the following scale counts: dorsals between axilla and groin, 23 to 33 (mean, 27.3); ventrals between axilla and groin, 24 to 36 (mean, 29.7); midbody scales, 41 to 54 (mean, 46.7); internasals, 0 to 3 (mode, 1); upper labials to center of eye, 2 or 3 (mode, 3); fourth toe lamellae, 5 to 11 (mean, 9.2; mode, 9); scutcheon 3 to 7 \times 14 to 26. Largest example of each sex 26 mm snout-vent length.

The large amount of material from various islands on the Great Bahama Bank is remarkably similar in features of scalation and pattern. Most significant of the latter is the absence of, or only occasional female specimen which shows but a faint indication of, the scapular spot and ocelli — both very faint and obscure — and the absence in adult males of the heavily dorsally spotted condition of *S. n. notatus*. A very few males show some head spotting, but this does not extend onto the body itself. The throat in males is usually immaculate (or actually stippled as in females) although an occasional specimen has some dark dotting in this area. If the throat is dark dotted, this condition is not necessarily correlated with assumption of adult head pattern (for example, two spotted males from Eleuthera, ASFS 17530 and ASFS 17579, which have unspotted

throats, and an unspotted-headed male from South Bimini, ASFS X4670, which has a relatively heavily spotted throat).

Of interest is the variation in frequency of some scale characters on various islands. For example, of eight specimens from New Providence, three lack an internasal; these are the only specimens of *amaurus* examined with this condition. Of twenty-one specimens from South Bimini, ten have two internasals; of thirty specimens from Cat Island, only seven have two internasals. The specimen with the highest number of midbody scales is from Cat Island, that with the lowest number is from South Bimini. The specimens with the lowest dorsal scale counts are from Great Exuma and Cat Island, whereas that with the highest dorsal count is from Cat Island. Dorsal scales on South Bimini range between 24 and 29 (fifteen specimens), on Eleuthera between 24 and 29 (fifteen specimens), and on Cat Island between 23 and 33 (twenty-eight specimens). A small series of six specimens from Long Island has the dorsals ranging from 26 to 30.

The iris color on Cat Island specimens was brown, that of Eleuthera specimens yellowish-brown, and that of South Bimini specimens golden. Three males from Eleuthera had the head yellowish-buff, and the throat distinctly yellow. South Bimini specimens were not yellow-headed or yellow-throated. Typically, Bahama specimens have the underside of the tail pale reddish to coral in color.

COMPARISONS: *S. n. amaurus* differs from *n. notatus*, and *atactus* in smaller adult size, and from *exsul* in larger size. In dorsal scales and midbody scales, *amaurus* differs from the previously described three races in having higher average counts, although the midbody count is closest to that of *exsul*. In absence of a scapular spot and ocelli, *amaurus* is readily distinguished from *exsul*. From female *n. notatus*, *amaurus* differs in lacking the spot and ocelli, and male *amaurus* seldom achieve the spotted head and dorsum of male *n. notatus*. Both sexes of *amaurus* and *atactus* are much alike in pattern, although some individuals of both sexes of *atactus* have a scapular spot and ocelli.

S. n. amaurus is the only subspecies of *notatus* in which the modal number of fourth toe lamellae is nine; all other races have a mode of ten scales. The mean number of fourth toe lamellae in *amaurus* is 9.2; this mean is exceeded in the races *notatus* (9.6) and *atactus* (9.8), and is equal to the mean in *exsul* (9.1). The single very low lamellae count (five scales) in *amaurus* is from a specimen from Cat Island; this count is the lowest of any specimen of any subspecies examined; the count is due to the fragmentation of the basal lamellar scales, so that there are but five entire scales across the underside of the toe.

Sphaerodactylus notatus peltastes, new subspecies

TYPE: AMNH 74752, an adult female, Hopetown, Elbow Cay, off Great Abaco, Bahama Islands, 4 May 1953, George B. Rabb. Original number VV-3154.

PARATYPES: AMNH 74753-54, same data as type; AMNH 72926-31, same locality as type, 16 June to 4 July 1951, W. G. Hassler.

ASSOCIATED SPECIMENS: Bahama Islands, Grand Bahama, Freeport, ASFS V2069-71; High Rock, MCZ 37958; Eight Mile Rock, MCZ 42092 (79 speci-

mens); Stranger's Cay, MCZ 6971; Water Cay, MCZ 42091 (40 specimens); *Great Abaco*, nr. Marsh Harbor, AMNH 74745-47; Marsh Harbor, AMNH 72925; Mores Island, MCZ 42090; Pensacola Cays, Allans Cay, AMNH 74748-51; *Little Abaco*, MCZ 6974.

DISTRIBUTION: Little Bahama Bank.

DIAGNOSIS: A subspecies of *Sphaerodactylus notatus* characterized by a combination of large size (adult males to 33 mm snout-vent length, adult females to 34 mm snout-vent length), large number of dorsal scales between axilla and groin (25 to 35, mean 30.1 ± 0.21), large number of scales around body at midbody (46 to 55, mean 49.9 ± 0.28), and a scapular spot and ocelli at least indicated in some individuals of both sexes.

DESCRIPTION OF TYPE: An adult female with the following measurement and counts: snout-vent length, 33 mm; tail, broken near base; dorsal scales between axilla and groin, 32; ventral scales between axilla and groin, 36; scales around body at midbody, 53; internasals, 2; upper labials to center of eye, 3; fourth toe lamellae, 10.

Dorsum tan, marked with dark brown scales which on the body are not arranged in any discernible pattern; head pale tan with three longitudinal lines, the central one beginning on the rostral and continuing posteriorly onto the nape where it is somewhat expanded and hollowed centrally, and thence posteriorly to become diffuse and blend into the small black scapular spot which encloses two white ocelli; lateral longitudinal lines beginning on the snout, following the canthus rostralis, crossing the eye, joining the scapular spot laterally and continuing onto the shoulders where they become diffuse; the entire head pattern lacks the dark and contrasting distinctness usual for the species, and the lines themselves are somewhat "hollowed" by the intermingling of pale tan scales with the dark brown scales of the lines; upper surfaces of limbs tan with scales edged with brown; all ventral surfaces cream stippled with brown, densest posteriorly and along sides of abdomen; chin and throat finely stippled with brown, the stippling not forming a pattern.

VARIATION: Because of certain variations in pattern and scalation, specimens from the Abacos and associated cays will be discussed separately from those from Grand Bahama and associated cays.

The paratypes include five males and seven females. With them will be discussed three males and a juvenile from Marsh Harbor, *Great Abaco*; a single male from Mores Island; and a single female from *Little Abaco*. In this series, there is a distinct tendency to have the scapular spot at least indicated; only 21% of these lizards lack any indication of the spot. More males have the spot than do females. In those specimens of both sexes which have the spot, its actual intensity and extent vary widely, and in some lizards there may be merely two tiny white dots without any dark pigment around them to indicate the presence of the spot itself. The dorsum is usually quite pale tan, at times flecked with brown, or even marbled (AMNH 74751) in one female. Although the

males are large (largest 33 mm), none shows any indication of head spotting, although the body itself may be spotted; none shows a throat pattern which, judging from other specimens, is correlated with the unicolor or finely dotted heads. The scapular spot in two males is tiny but very black, and thus exceeds in depth of pigmentation that of any of the females, wherein the spot is a very dark brown when observed with the naked eye. The lined head pattern in females (as in the type) is somewhat less well defined and clear-cut than in other forms, and is more diffuse, although the lines are nonetheless obvious. The female from Little Abaco and the male from Mores Island lack scapular spots, and it is absent as well in a juvenile from Allans Cay. The largest female measures 34 mm in snout-vent length.

In seventy-five specimens from Grand Bahama, 84% of the lizards lack any indication of a scapular spot and ocelli; when best expressed, the spot in this series is not so intense as in the Abaconian material, and no Grand Bahama males have the compact black dots on the shoulders. On the other hand, a very large number of males have darkly marbled or mottled heads, and equally well marked throats; the females have the head pattern more distinct than in Abaconian females. On size, despite the much larger series of Grand Bahama specimens, the largest male measures 32 mm snout-vent and the largest female 31 mm. Although the differences in snout-vent length between Grand Bahama and Abaco specimens is slight, it is rather remarkable that none of the Grand Bahama specimens reaches the slightly larger size of the smaller number of Abaconian geckos. The iris of Grand Bahama lizards is dull yellow, heavily speckled with brown.

In the series of forty specimens from Water Cay, off the north coast of Grand Bahama, 85% of the lizards lack the scapular spot and ocelli. Only one of eighteen males has the heavily patterned throat of grand Bahama males, and, although several males have some spotting on the head, none has the head so complexly and contrastingly patterned as Grand Bahama males. The head pattern in females is intermediate in clarity between Abaconian and Grand Bahaman females. In size, the Water Cay specimens resemble those from Grand Bahama, the largest male being 30 mm in snout-vent length, the largest female 31 mm.

From the above discussion it is clear that Abaco specimens reach a slightly larger size than do those from Grand Bahama and Water Cay, Abaco and Water Cay males lack the complex head and throat pattern of Grand Bahama males, and that whereas Abaco *notatus* usually have scapular spots and ocelli, these features are absent in Grand Bahama and Water Cay material.

In scale counts, specimens from Water Cay are closer both in range and mean to specimens from Grand Bahama, as might be expected. However, in dorsals, ventrals and midbody scales, Water Cay geckoes have slightly higher counts (maximum difference, three scales at midbody) than do Grand Bahama lizards. Abaco specimens, on the other hand, average close to Grand Bahama specimens in dorsal counts (but slightly lower than Water Cay), higher than both Water Cay and Grand Bahama in ventrals (33.1 versus 30.5 and 30.8), and slightly than Water Cay-Grand Bahama in midbody counts. Escutcheon size in the three populations is comparable. Abaco fourth toe lamellae average (10.3)

higher than Gran Bahama fourth toe lamellae (9.6) with Water Cay intermediate (10.1); range and mode in all three samples are similar except that Abaco specimens reach a high count of 13, in contrast to 12 in the other two populations. The modal internasal number is 1, although 2 occurs more often in Water Cay and Grand Bahama specimens than in Abaconian lizards.

From the above discussion, it is clear that there might well be justification in separating Grand Bahama-Water Cay specimens nomenclatorially from the Abaconian *notatus*. Despite the excellent series from the two more northern islands, I am reluctant to separate the lizards of these two islands from those from Abaco and its associated islets. If more specimens from Abaco are taken, and these substantiate the differences suggested above (absence of adult male head spotting, larger size, relative widespread occurrence of scapular spot and ocelli) it is likely that the Grand Bahama-Water Cay material can be separated nomenclatorially from Abaco *notatus*.

COMPARISONS: *S. n. peltastes* differs from all other races in its larger size, being approached in this character only by the races *notatus* and *atactus*. Although a difference in only a few millimeters in snout-vent length may seem slight, the concomittant increase in bulk of the lizard is extremely evident. Compared to *atactus* and *n. notatus*, *peltastes* is simply a conspicuously larger and bulkier lizard. The higher number of dorsals and midbody scales will differentiate *peltastes* from all other forms; in this character it is approached most closely by *amaurus* (which however is much smaller), and although there is overlap between the counts, the differences are statistically significant. In pattern, due especially to the variability in populations of *peltastes* as shown above, precise comparisons with other races are not worth while. Even in the single race which apparently possesses a scapular spot and ocelli in all specimens (*exsul*), the actual extent and intensity of the spot and the ocelli varies so greatly that some specimens are quite like patterned *peltastes*. The most pertinent comparison is between geographically adjacent *peltastes* and *amaurus*; these two races are distinguished by the much larger size of *peltastes*, and higher average scale counts (including 10.1 fourth toe lamellae in contrast to 9.2). From *n. notatus* on the adjacent mainland, *peltastes* differs in larger size, higher average scale counts, and in having some males with a scapular spot and ocelli, a condition not known to occur in *n. notatus*.

Sphaerodactylus inaguae Noble and Klingel

As stated in the introduction to the present paper, one other species of Bahaman gecko, *S. inaguae* from Great Inagua, is structurally like *S. notatus*. Various students and curators have at various times suggested, either by use of the combination *S. n. inaguae* or in conversation, that *inaguae* should be regarded as a race of *S. notatus*. Also, there is reason to believe that *notatus*, *inaguae* and *difficilis* Barbour (from Hispaniola) may all be conspecific. Since the latter species, as presently defined, is composed of a large number of quite distinct subspecies, and since Benjamin Shreve is currently working upon the problem

of variation in *S. difficilis*, it is profitless to discuss the Hispaniolan species in any detail.

S. notatus in the Bahamas presents a very neatly compact range; the two races *peltastes* and *amaurus* occupy, respectively, the Little Bahama and Great Bahama banks. The only large island whence *notatus* is unknown in this general region is Andros. There are likewise no records for Great Exuma, although the species likely occurs there, since it has been reported from the Exuma Cays. As far as known, *S. notatus* is absent from San Salvador, Rum Cay, Crooked and Acklin's islands, Atwood, and Mayaguana — *i. e.*, the islands south of the Crooked Island Passage and the isolated Rum and San Salvador. The species does occur, however, on Cat Island, which is not part of the Great Bahama Bank. Of the islands from which *S. notatus* is unknown, *S. corticolus* occurs on Rum Cay and San Salvador, *S. mariguanae* is known from Booby Cay off Mayaguana (but apparently not from the main island itself). No *Sphaerodactylus* of any species have been reported from Crooked and Acklin's islands, Atwood or the Plana Cays. The presumed absence of these geckoes from at least the Crooked-Acklin's group is rather astonishing; since sphaerodactyls are so widespread in the West Indies and are able to inhabit even small barren islets, one might suspect that these two islands do indeed have some species of *Sphaerodactylus* which is as yet either unreported or collected. Be that as it may, there is apparently, then, a distinct hiatus between the range of *S. notatus* and *S. inaguae* of about 179 miles.

The island of Great Inagua, along with Little Inagua, lies on its own bank at the southwestern extremity of the Bahamas, and slightly to the south of the more eastern Turks and Caicos groups. From the adjacent Caicos Bank islands *S. caicosensis* has been described; this species is much like *notatus* (and *inaguae*) in many ways, but differs structurally in having keeled, rather than smooth, gular scales. To the south of Great Inagua lies the large island of Hispaniola, only some 80 miles distant; Ile de la Tortue, off the north coast of Hispaniola (whence sphaerodactyls are presently unknown) is slightly nearer. It may be seen that Great Inagua is closer to Hispaniola (which is occupied by *difficilis*) than to the Great Bahama Bank (which is occupied by *notatus*) by almost 100 miles.

There are no structural features differentiating *S. notatus* from *S. inaguae*, as far as I can determine. I have made no attempt to study large series of *inaguae*; however, of the sixteen specimens I have examined, the dorsal scales between axilla and groin range between 24 and 32, the midbody scales between 45 and 52. The former count averages (27.8) close to the mean for *amaurus*; the latter count averages (48.5) nearest to midbody counts of *peltastes*, and is distinctly higher than midbody averages for all other subspecies. In size, *inaguae* agrees with *notatus*, the largest specimen either reported or examined by me is a large adult male with a snout-vent length of 29 mm. In snout-vent length, *inaguae* is smaller than *peltastes*, larger than *amaurus* and *exsul*, and equal to *n. notatus* and *atactus*.

In coloration and pattern, *inaguae* resembles *notatus* in several ways. According to NOBLE and KLINGEL (7), the males have a series of large dark

brown spots on the head and a body pattern of a few small and indistinct spots, whereas females have three longitudinal stripes of dark brown on the head, a large dark spot on the scapular region surrounded by a narrow dark line to form a more or less rectangular "target", and a body pattern of a few small dark blotches or indistinct cross-bands. However, just as in *S. notatus*, these authors noted that "fully adult males . . . may have a spotted, striped, or rarely a plain head. Adult females . . . usually have a striped head but the color pattern may be very weakly developed. . . . Since immature specimens have essentially the pattern of the female, it would appear that a small percentage of the males may reach sexual maturity before they have lost the "target" and acquired the head-spotting characteristic of the male". Note that in none of the above descriptions is there any mention of ocelli — the "target" or scapular spot being the only shoulder pattern figure present. This is confirmed by the examination of the specimens at hand.

Of my sixteen specimens, seven are males, (five fully adult and two subadult), six females, and two juveniles. All juveniles, females, and one subadult and one adult male have a scapular spot. Other adult males lack this element and have a spotted head with faint body flecking. No specimen has any throat pattern, even fully adult males. The tri-partite head pattern in the female is very similar to that in female *S. notatus*. However, the median stripe is twice constricted, stops short of the scapular spot, and does not continue further posteriorly than the shoulders. There is no indication of alignment of the dorsal body dark spots, which are quite conspicuous compared with the same markings in *S. notatus*. The impression is that *inaguae* has the female head pattern more restricted, slightly different in form from, and much more clear-cut than, the female head pattern in *S. notatus*.

S. difficilis presents such a wide variety of pattern and coloration throughout its range that it is futile to compare *inaguae* with it without a detailed discussion of variation in the former. The similarities between the two include the presence of a scapular spot (although usually this is accompanied by one or two ocelli), and lined heads in females. The median female head stripe is twice constricted, as in *inaguae*. I cannot distinguish the two species structurally.

One other feature of *inaguae* is important. The iris color (NOBLE and KLINGEL, 7) is pale blue. All races of *notatus* for which I have iris color data have the iris varying from yellow or golden to brown. *S. difficilis* has a dark (brown) iris. In this feature, *inaguae* differs from its two adjacent relatives.

In summary, I consider that *S. inaguae* is sufficiently distinct from *S. notatus* to be regarded as a distinct species. That it is allied to it and to *difficilis* is clear. If it is imperative to combine the name *inaguae* with either *difficilis* or *notatus*, at least *difficilis* might be more appropriate geographically. It is possible that when the variation in *difficilis* is well known that *inaguae* can be shown to resemble closely one or several of the races on Hispaniola. However, I feel that *S. inaguae* should not be arranged as a race of *notatus*, and to combine it prematurely with *difficilis* is likewise imprudent.

One specimen of *S. notatus* from Matthewtown, Great Inagua (USNM

81270) and two from Northeast Cay, Morant Cays (MCZ 52043-44) are of interest. The former is an adult male (snout-vent length 26 mm) with a plain head, spotted dorsum and unpatterned throat; there are no scapular spot or ocelli. The moderate snout-vent length rules out only *exsul* for consideration as the parent subspecies for this introduced lizard. Although it equals male *amaurus* in snout-vent length, it seems somewhat too stout and bulky for that subspecies. It is not so large as *peltastes*, and I do not consider it that subspecies. Since Great Inagua has long been a shipping center in the southern Bahamas, and even today there are direct shipping connections by native sloop between it and Florida and Hispaniola (and in the recent past with Cuba which lies only about 45 miles to the southwest), the specimen may with logic considered to be a representative of one of the races *notatus* or *atactus*. Of these two, I find *atactus* the more attractive possibility. There has long been trade between Great Inagua and Baracoa (an area where *atactus* is known to be fairly common), and it is not unlikely that the Matthewtown lizard arrived on Great Inagua from the Oriente port.

The two specimens from the Morant Cays south of Jamaica (a male and a female, each with a snout-vent length of 27 mm) I assume likewise to be introductions, although in this case there is of course the possibility that these lizards come from a native population. Both lack scapular spots and ocelli and have 20 and 23 dorsal scales and 44 midbody scales. Their size and lack of shoulder pattern eliminate *exsul* from consideration: they are too small and have too few scales to be *peltastes*. The dorsal scale count of 20 lies below the known ranges of *n. notatus* and *amaurus*. The specimens agree quite well in both pattern and scalation with *atactus*. The occurrence in one of the specimens of two internasals even suggests that they may have originated on the Isla de Pinos. The Morant Cays are about 180 miles south of Santiago de Cuba. I have no knowledge of any shipping which regularly used to ply between Cuba and the Morant Cays. One means of introduction suggests itself. BOND (2) mentioned that at least one species of tern, *Sterna anaethetus*, nests on the Morant Cays. GRANT (5) mentioned that a Mr. Bodden of Little Cayman once had the contract to collect sea bird eggs on the Morant Cays. Knowing the gusto with which thousands of tern eggs are eaten in the West Indies each year, it is not improbable that sloops from Cuba have at various times gone from Oriente to the Morant Cays to collect eggs and bring them back for consumption in Cuba. Such a supposition is no less logical than that of a Cayman Islander traveling from Little Cayman to the Cays — distance of some 350 miles — to return with eggs to Jamaica.

DISCUSSION

Sphaerodactylus notatus is divisible into five subspecies which vary in scalation, coloration, and pattern. The Cuban subspecies *atactus* has the lowest scale counts and is intermediate in size. It also occupies the largest single insular land mass presently occupied by *S. notatus*, a land mass which, though it has been variously inundated in the past, has remained as at least an archipelago or as several disjunct rather large islands. If we postulate Cuba as being the place origin

of *S. notatus*, it is difficult to explain either why it has not differentiated on that island into recognisable subspecies or why it is not so common in western as in eastern Cuba. The latter may be an artifact of collecting, of course; if the scarcity of *S. notatus* west of Camagüey Province is real, it may be due to the occurrence in the west of *Sphaerodactylus cinereus* which is common as far east as Las Villas Province and occurs sparingly in Camagüey and Oriente provinces (the occurrence in Oriente is based upon BARBOUR, 1, and unsupported by collection of specimens by me). It is thus possible that *cinereus* and *notatus* have roughly complementary ranges in Cuba, *cinereus* being primarily a western species and *notatus* an eastern one, although each has apparently invaded the range of the other to some slight degree. If western populations of *notatus* are small and scattered it is not improbable that, were sufficient material available from the western part of the island, there might indeed be differentiation in specimens from that area in contrast to those from eastern Cuba. It is most unusual, incidentally, that a species which is common on the Isla de Pinos should be rare in western Cuba. The Pinar del Río-Isla de Pinos faunal similarities are now well documented, both in herpetology and ornithology. If Isla de Pinos *notatus* are somewhat different from Cuban *notatus* in pattern and in at least one scale character (internasals), it would seem likely that this population has evolved independently from Cuban geckos for a long period. Possibly western Cuba and Isla de Pinos *notatus* might be found to be similar, as is the case in several examples of east-west Cuban races.

Eastern Cuba, in contrast to western Cuba, has obviously been a primary site of evolution in *Sphaerodactylus*. At this time, there are recognized no less than four species (*alayoi* Grant, *ramsdeni* Ruibal, *ruibali* Grant, and *spielmani* Grant) which are restricted to Oriente; to this list may be added *decoratus torrei* Barbour, a subspecies endemic to Oriente. In the remainder of Cuba there is one endemic species (*scaber* Barbour and Ramsden), *decoratus drapetiscus* Schwartz in Habana and Matanzas provinces, *argus* Gosse from Las Villas to Oriente, *oliveri oliveri* Grant in Las Villas, and *cinereus* in western and central (and eastern) Cuba. The Isla de Pinos has *notatus*, *cinereus* and *oliveri storeyae* Grant, the latter an endemic subspecies. Of the non-eastern forms, *S. argus* presumably has originated on Jamaica and has secondarily invaded Cuba. The high degree of endemism in eastern Cuba is obvious from the above brief summary; it is reasonable to suppose that *S. notatus* may have evolved here as well (although it presently has no close relatives elsewhere in Cuba).

If we assume that Cuba was the place of origin of *S. notatus*, then *S. n. exsul* is the southern derivative of *S. n. atactus*, differing in smaller size but greater number of dorsals and ventrals, always having a scapular spot and ocelli, and a lower number of fourth toe lamellae. The herpetofauna of the Swan Islands shows at least one other Cuban element, *Alsophis brooksi*, which is probably conspecific with the Cuban and Caymanian *Alsophis cantherigerus*. The constant occurrence of scapular spot and ocelli in *exsul* may be accounted for by the fortuitous colonization of Little Swan by members of the parent Cuban population which possessed this feature. The similarity in number of midbody

scales is suggestive of lack of divergence in this character from the parent Cuban stock.

The races *notatus*, *amaurus* and *peltastes* form, in scale count, a nicely graded series from *atactus*. Of them, *notatus* seems closest to *atactus* not only scalewise but geographically. If, however, we assume that *atactus* is rare in western Cuba, it is possible that the Florida colonization was made, not directly by the shortest distance across the Straits of Florida to the Keys, but rather by a roundabout route via the Great Bahama Bank. This latter route has less to recommend it than the former; it would thus be assumed that *notatus* reached Florida not via the Keys and thence colonized the mainland, but rather arrived on the mainland and thence penetrated down into the Keys. The rather limited mainland distribution of the species argues against this, although admittedly the occurrence of *S. notatus* only in southeastern Florida does make it conceivable that arrival from the Bahamas might well have occurred. On the other hand, *S. notatus* may have been, or may be, common in western Cuba, in which case continental arrival from the northwestern coast of Cuba is an attractive postulation. In any event, continental *notatus* resembles *atactus* in size and in the occurrence of scapular spot and ocelli in females, and I regard it as a direct derivative of *atactus*.

The two Bahaman races differ so strongly in size that they seem more divergent from one another than do *atactus* and *exsul*, for example. I assume that *peltastes* has evolved (and apparently is still differentiating) on the Little Bahama Bank, and has long been separated from Great Bahama Bank *amaurus*. The apparent similarity of specimens from islands as separated as widely as South Bimini, Eleuthera, and Cat Island is surprising. It is possible that with large series from all the Great Bank islands, constant and significant differences between various islands or island group populations may be discovered. At this point, there is no evidence that such is the case.

I cannot see that *amaurus* in pattern or size is nicely intermediate between parent *atactus* and *peltastes*. The regular absence of scapular spot and ocelli in *amaurus* is difficult to reconcile with the occurrence of the spot and ocelli in both sexes of *peltastes*. *Amaurus* is likewise smaller than both *atactus* and *peltastes*, and derivation of *peltastes* from *amaurus* would require a reversal of trend in size. However, *amaurus* is intermediate in scalation between *atactus* and *peltastes*, and perhaps more emphasis should be placed on this character than on either size or pattern. I have considered also the possibility, which is attractive on the surface, that *peltastes* is more closely related to *n. notatus* than to *amaurus*. This would require a reinvasion of the Little Bahama Bank from Florida, or possibly a colonization of the bank directly from Cuba more or less synchronously with that of Florida. Such an arrangement would leave *amaurus* as a separate entity isolated on the Great Bahama Bank and derived independently from Cuba. The two proposals (a series *atactus-amaurus-peltastes* with *notatus* a separate derivative of *atactus* or a series *atactus-notatus-peltastes* with *amaurus* a separate derivative of *atactus*) are about equally tenable, but both present certain difficulties which presently cannot be solved.

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Fig. 1. Map of the Bahamas, Cuba, and southern Florida, showing the distribution of *Sphaerodactylus notatus*, as follows: *notatus*, crosshatching; *exsul*, widely spaced vertical lines; *atactus*, dense stippling; *amaurus*, fine vertical lines; *peltastes*, open stippling. For the sake of clarity several localities have not been mapped.

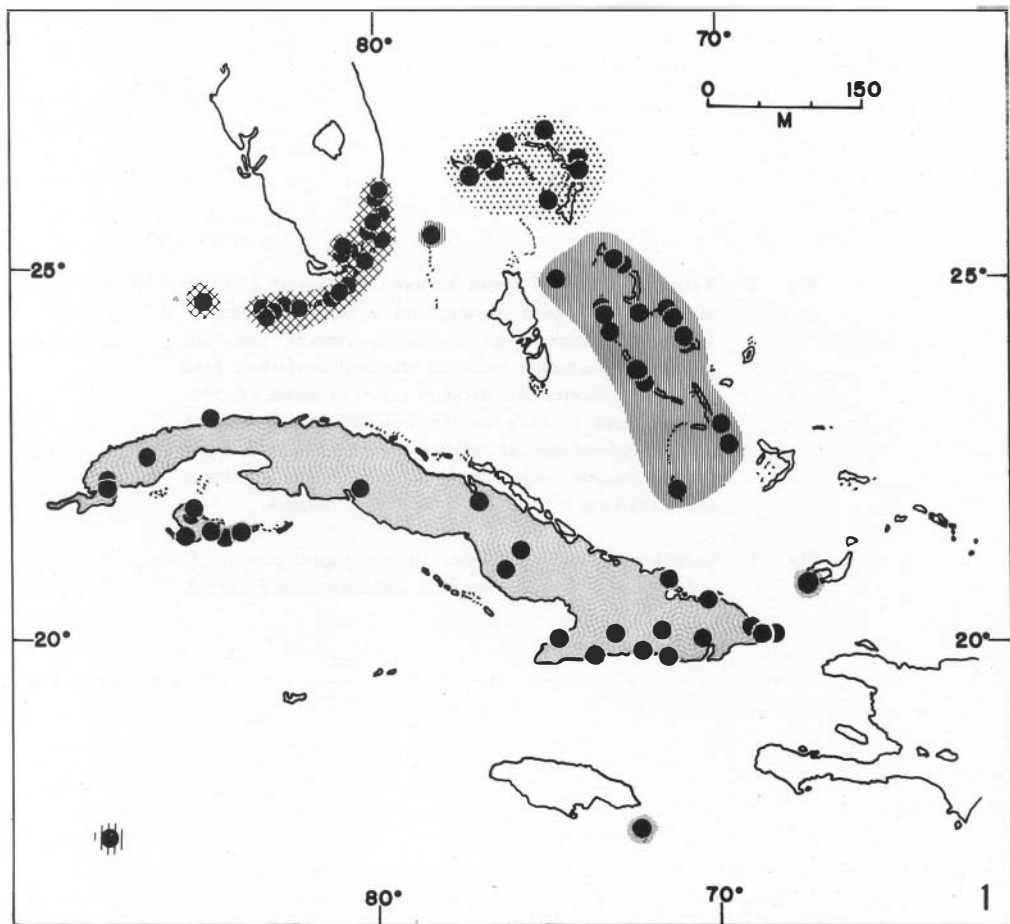


Fig. 2. Variation of dorsal scales between axilla and groin in six populations of *S. notatus* and *S. inaguae*. Horizontal line indicates range of counts; vertical line, the mean; low rectangle indicates standard deviation; high rectangle indicates two standard errors of mean. Number of specimens in each sample indicated to left of each line. Samples coded as follows: 1) *peltastes*, 2) *amaurus*, 3) *notatus*, 4) Cuban *atactus*. 5) Isla de Pinos and Canarreos *atactus*. 6) *exsul*, 7) *S. inaguae*.

Fig. 3. Variation in midbody scales in six populations of *S. notatus* and *S. inaguae*. Symbols and data as in Figure 2.

